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DETERMINATION OF PERFORMANCE OF THE CAR DIAGNOSTICS STAND WITH THE HELP OF SOLIDWORKS

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Abstract: continuation of determining the efficiency of the stand of diagnostics of automotive equipment based on the use of SolidWorks and its application SolidWorks Simulation (the possibility of replacing steel 45 for the manufacture of shaft on steel 15).

Keywords: diagnostics, stand, SolidWorks Simulation, material replacement.

Costs for maintenance and repair of cars at service stations remain quite high. At the same time many cars are operated with malfunctions and considerable deviations of regulating parameters of a technical condition of units and mechanisms from optimum.

The share of traffic accidents caused by car malfunctions also remains high. Many cars have higher fuel consumption. All this is caused, first of all, by the lack of necessary conditions for timely and high-quality assessment of the technical condition of transport vehicles

The reduction of negative factors that affect the quality of maintenance and repair of cars, contributes to the widespread introduction of modern methods and tools of technical diagnostics, including bench tests (diagnosis - the process of determining the technical condition of the machine or its individual units by disassembled methods). Their advantages compared to road tests are the absence of the need to go to the landfill, the ability to set a wide range of test parameters. Their advantages compared to road tests are the absence of the need to go to the landfill, the ability to set a wide range of test parameters.

The most important characteristics of the car are subject to diagnosis: power consumption, speed of movement, acceleration, movement on inertia (run-out), fluctuations, vibrations, a way of braking, a fuel consumption, etc.

Thus, technical diagnostics is a branch of science that studies and establishes signs of malfunctions of machines and their mechanisms; develops methods and means by which the diagnosis of the nature and essence of faults is made. Technical diagnostics determines a rational sequence of checks of mechanisms and on the basis of studying of dynamics of parameters of a technical condition of units and assembly units of the car solves a question of forecasting of their resources and trouble-free work.

The practical purpose of technical diagnostics - definition with the minimum expenses of work and time of a technical condition and the reasons of malfunctions of the car without dismantling and issue of recommendations on its maintenance and repair.

Depending on the results of solving these problems, diagnostics give practical recommendations that establish:

1) during maintenance – the reasons for failures; the need to adjust the mechanisms or replace individual parts and mechanisms during the next periodic maintenance; the need to send assembly units, units and machines in general to specialized repair companies for overhaul or in the workshop of the farm, at the service station for ongoing repairs;

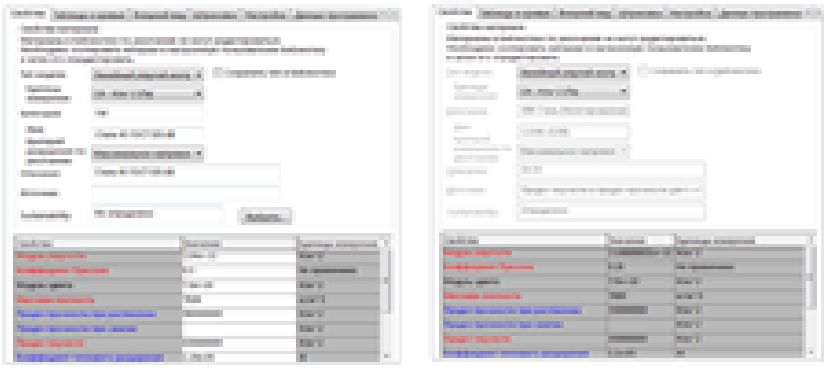
2) for current repairs – a list of parts and components to be replaced, as well as mechanisms that require adjustment.

Therefore, the aim of this study is to continue to determine the performance of the stand of diagnostics of gearboxes and drive axles of vehicles based on the use of CAD/CAE systems and the finite element method. The design of the diagnostic stand and the principle of its operation are given in [1].

The beginning of the study is an extreme case that may occur when assembling the diagnostic stand - weakening (or absence) of the right bolt securing the bearing support, resulting in skew of the drum shaft [2]. Continuation – calculation of the shaft of the chain drive tensioner [3].

In all these studies, computer simulations were used for the calculations. It examines the stress-strain state of solids using the SolidWorks 3D-system. Modern methodology allows you to build an accurate model of the part and the finite element method to determine the operating parameters (SolidWorks Simulation application) that occur in it under specific operating conditions.

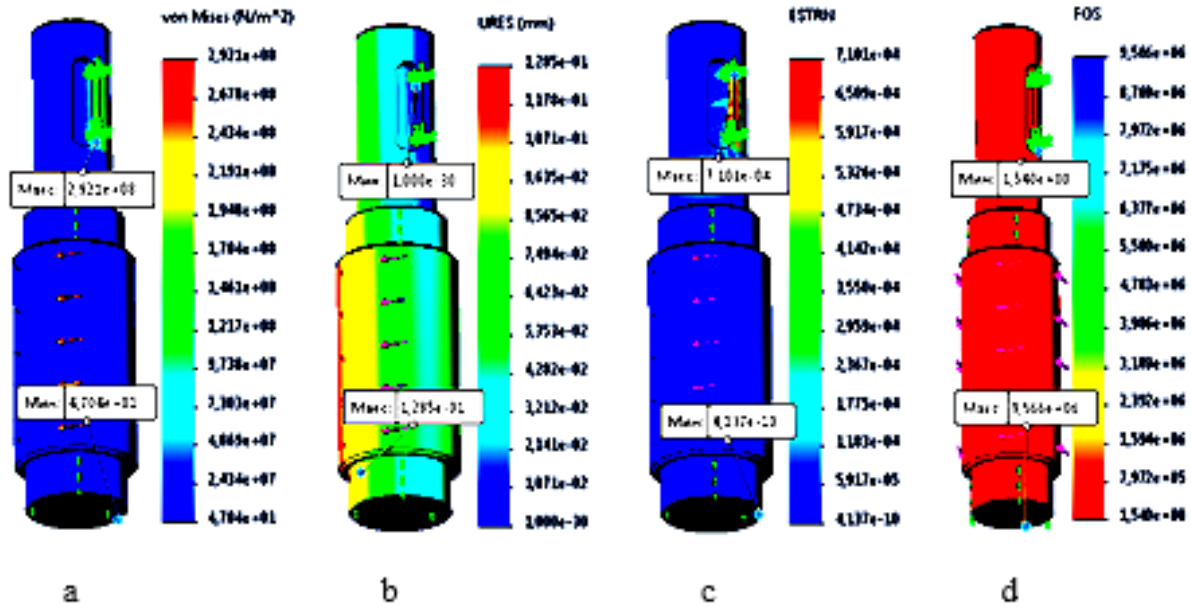
The last study of the efficiency of the diagnostic stand – static exploration of its shaft [1], the material of which is steel 45 GOST 535-88. When analyzing the simulation results, it was found that the minimum force margin of the shaft is $n = 2.903$, which is more than the allowable $[n] = 1.5$. Therefore, the aim of this work was to determine the possibility of replacing this material with another, more available in repair shops, for example, steel 15 DIN 1.1141 (C15E) – fig. 1.



a b

Fig. 1. Properties of steels 45 (a) and 15 (b)

Repeated calculations in SolidWorks Simulation divided the shaft model into finite elements [4], built a stiffness matrix; the synthesis of a finite-element model was carried out taking into account the conditions of its fixation at the nodal points; the obtained system of algebraic equations is solved; the components of the stress-strain state are determined (fig. 2, table 1).



a b c d

Fig. 2. Plots of total stresses von Mises (a), displacements URES (b), equivalent deformations ESTRN (c), strength reserve FOS shaft

Table 1

The results of the study of the shaft

Steel	Tension (maximum), σ, MPa	Moving (maximum), h, mm	Deformation (maximum), δ, mm	Margin of safety (minimum), n
45	285,945	0,131668	0,000735392	2,903
15	292,1	0,1285	0,0007101	1,540

Since the minimum safety factor for the shaft made of steel 15 is n = 1,540, in the case of replacing steel 45 with this steel for its manufacture, the safety margin is sufficient (allowable safety factor [n] = 1,5).

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